COMPREHENSIVE PAVEMENT DESIGN MANUAL

Chapter 6 - Materials

Revision 10

October 17, 2022

CHAPTER 6
MATERIALS

Contents **Page**

LIST OF FIGURES

LIST OF TABLES

6.1 INTRODUCTION

This chapter is a summary of current design related material issues for:

- Asphalt pavement layers
- Portland Cement Concrete (PCC) pavements
- Permeable base
- Subbase
- Selected subgrade layers.

The asphalt pavement layers consist of top, binder, and base courses. A description of each specification related to each layer of material is presented in this chapter.

6.2 ASPHALT MIXTURES

6.2.1 General

The standard method of designing asphalt mixtures is a modified version of the Superpave system. Asphalt mixtures can be placed quickly, and traffic can be restored in a short amount of time. Mill and fill operations make rehabilitation of asphalt pavements quick and easy because the shoulders contain the same top layer thicknesses and can be milled at the same time. With proper design, construction and maintenance, asphalt pavement surfaces should have life spans of 15 to 18 years for thicker overlays and 10 to 15 years for single course overlays before rehabilitation, while the subbase and underdrain system should last 50 years.

The Superpave mixture design system and Performance-Graded Binder (PG Binder) specifications were developed through research performed during the Strategic Highway Research Program. The binder and mix requirements are selected to accommodate the diverse, but specific, climate and traffic conditions that pavements are exposed to at project sites across the State.

The objective of the mix design system is to define an economical blend of PG Binder and aggregate yielding a paving mixture having sufficient air voids, voids in the mineral aggregate (VMA), and voids filled with binder (VFB) that will perform satisfactorily over the pavement's service life.

New York State has transitioned from the use of hot mix asphalt to warm mix asphalt. The use of a Warm Mix Asphalt (WMA) technology can reduce environmental impacts by allowing the asphalt mixture to be produced at a lower mixing temperature than would be necessary to achieve the required pavement density with a similar HMA under similar conditions. Items in Standard Specification Section 404 – *Asphalt Pavements* should be specified to require the use of a warm mix asphalt technology.

6.2.2 ESAL Calculations

Refer to section 4.5.1 of this manual for the ESAL calculation except for the input parameters since the recommended parameters in Section 4.5.1 are intended for structure selection and are generally overly conservative for mix design. Mix design ESALs should not be overestimated for the following reasons:

1. The aggregate properties and binder specified may be restrictive and costly, and

2. The pavement's anticipated service life may not be obtained if the predicted traffic is not existent to provide reworking and compaction of the asphalt.

Therefore, when calculating ESALs for Superpave mix design, the following parameters should be used in the "simple" method for compound traffic growth as described in Chapter 4 of this manual.

Criteria	Input Parameter
Design Life	20 years
Percent of Trucks in Design Lane	1 lane = 100, 2 lanes = 85, 3 lanes = 70, 4 lanes = 60
Compound Truck Weight Growth Rate	0.5%
Compound Truck Volume Growth Rate	2%

The ESAL calculations are not required for Parkways where truck traffic is prohibited. (see Section 6.2.6 of this chapter).

6.2.3 **Asphalt Mixture Item Selection Guidelines**

Selection of the specific asphalt mixture item type will involve the decision steps as laid out moving from left to right in Tables 6-1 and 6-2. The decisions are as follows.

1. What is the project's Functional Classification as defined in the *Pavement Data Report* (see Table 6-3)?

2. If it has a Principal Arterial classification, does it have either full or partial control of access?

3. a. What is the traffic volume? "High volume" refers to 2 or 3 lane highways with design year two-way AADT over 8000, or for more than three lanes, with two-way AADT over 13,000. Low volume refers to highways with lower volumes for the specified number of lanes.

   b. What is the project's location? For Tables 6-1 and 6-2, the City of New York, and the surrounding counties of Dutchess, Nassau, Orange, Putnam, Rockland, Suffolk, and Westchester are referred to as "Downstate". All other areas are referred to as "Upstate".

   c. What is the 20-year ESAL count? Does the project involve asphalt mixture quantity of less than 2000 tons of top course? (Regardless of the quantities of each of the layers below). Are the calculated ESALs less than 0.3 million? This will determine the aggregate size and the pay item.

Table 6-1 Pay Item Selection for Principal Arterials

Functional Classification	Control of Access	Traffic Volume[1]	Location[2]	Estimated top course < 2000 Tons OR ESALs < 0.3 million[7]	Asphalt Mixture Pay Item [3,4,5,7]
11 - Urban Principal Arterial Interstate 12 - Urban Principal Arterial Expressway 14 - Urban Principal Arterial Other 01 - Rural Principal Arterial Interstate 02 - Rural Principal Arterial Other	Full or Partial Control of Access	High or Low	Downstate		404.XX51QR (Top) 404.XX59QR (Binder) 404.XX69QR (Base) 404.0681QR (Top)[6]
			Upstate		404.XX52QR (Top) 404.XX59QR (Binder) 404.XX69QR (Base) 404.0682QR (Top)[6]
	No Control of Access	High	Downstate	No	404.XX61QR (Top) 404.XX69QR (Base and Binder) 404.0681QR (Top)
				Yes	404.XX71QR (Top) 404.XX79QR (Base and Binder) 404.0681QR (Top)
			Upstate	No	404.XX62QR (Top) 404.XX69QR (Base and Binder) 404.0682QR (Top)
				Yes	404.XX72QR (Top) 404.XX79QR (Base and Binder) 404.0682QR (Top)
		Low	Upstate or Downstate	No	404.XX63QR (Top) 404.XX69QR (Base and Binder) 404.0683QR (Top)
				Yes	404.XX73QR (Top) 404.XX79QR (Base and Binder) 404.0683QR (Top)

1. “High Volume” refers to 2 or 3 lane highways with design year two-way AADT over 8,000, or for more than three lanes, with two-way AADT over 13,000. “Low Volume” refers to highways with lower volumes for the specified number of lanes.
2. The City of New York, and the surrounding counties of Dutchess, Nassau, Orange, Putnam, Rockland, Suffolk, and Westchester are referred to as “downstate.” All other areas are referred to as “upstate.”
3. XX aggregate sizes may be 37.5 mm, 25.0 mm, 19.0 mm, 12.5 mm, or 9.5 mm.
4. Q has been reserved for Quality Payment Adjustments.
5. R has been reserved for Revision Number.
6. Regional Materials Engineer (RME) must be consulted.
7. 70-series compaction can be chosen instead of 60-series compaction when the calculated ESALs are less than 3 million.

Table 6-2 Pay Item Selection for General Highways

Functional Classification	Traffic Volume[1]	Location[2]	Estimated top course <2000 Tons OR ESALs < 0.3 million[6]	Asphalt Mixture Pay Item [3,4,5,6]
16 - Urban Minor Arterial 17 - Urban Collector 19 - Urban Local 06 - Rural Minor Arterial 07 - Rural Major Collector 08 - Rural Minor Collector 09 - Rural Local	High	Downstate	No	404.XX61QR (Top) 404.XX69QR (Base and Binder) 404.0681QR (Top)
			Yes	404.XX71QR (Top) 404.XX79QR (Base and Binder) 404.0681QR (Top)
		Upstate	No	404.XX62QR (Top) 404.XX69QR (Base and Binder) 404.0682QR (Top)
			Yes	404.XX72QR (Top) 404.XX79QR (Base and Binder) 404.0682QR (Top)
	Low	Upstate or Downstate	No	404.XX63QR (Top) 404.XX69QR (Base and Binder) 404.0683QR (Top)
			Yes	404.XX73QR (Top) 404.XX79QR (Base and Binder) 404.0683QR (Top)

1. "High Volume" refers to 2 or 3 lane highways with design year two-way AADT over 8,000, or for more than three lanes, with two-way AADT over 13,000. "Low Volume" refers to highways with lower volumes for the specified number of lanes.
2. The City of New York, and the surrounding counties of Dutchess, Nassau, Orange, Putnam, Rockland, Suffolk, and Westchester are referred to as "downstate." All other areas are referred to as "upstate."
3. XX aggregate sizes may be 37.5 mm, 25.0 mm, 19.0 mm, 12.5 mm, or 9.5 mm.
4. Q has been reserved for Quality Payment Adjustments.
5. R has been reserved for Revision Number.
6. 70-series compaction can be chosen instead of 60-series compaction when the calculated ESALs are less than 3 million.

Table 6-3 Functional Classification Code Descriptions

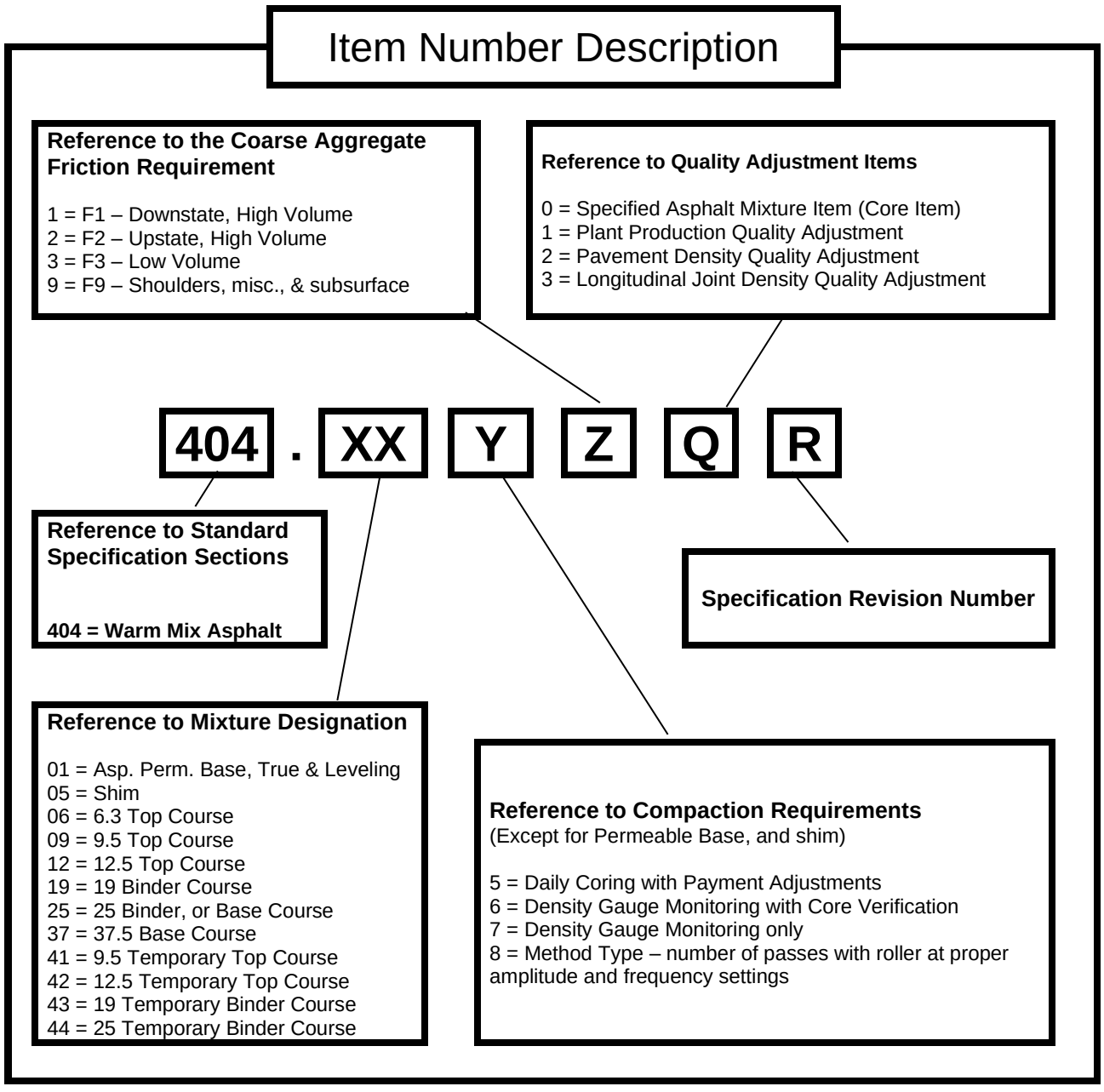
URBAN		RURAL	
Principal Arterial Interstate	11	Principal Arterial Interstate	01
Principal Arterial Expressway	12	Principal Arterial Other	02
Principal Arterial Other	14	Minor Arterial	06
Minor Arterial	16	Major Collector	07
Collector	17	Minor Collector	08
Local	19	Local	09

Source: Pavement Data Report

6.2.4 **Interpreting Asphalt Mixture Item Numbers**

Asphalt mixture item numbers vary based upon nominal maximum aggregate size, compaction requirements, coarse aggregate friction requirements, quality adjustment items, and specification revision number except for Permeable Base, True & Leveling, and Shim courses. Figure 6-1 provides a description of how to interpret asphalt mixture item numbers.

Figure 6-1 Item Number Description



6.2.5 **Performance Graded Binder Selection**

The specific Performance-Graded binder (PG binder) should be selected using the guidance in this section. The PG binder, which is used to bind the aggregate together, is selected based on the traffic conditions and environment to which the binder will be subjected to maximize its performance. **Table 6-4 Performance-Graded Binder Selection** includes the standard Polymer Modified PG binder grades that can be used in New York.

a. Polymer Modified PG Binders - The polymer modified PG binder grades are 64V-22 and 64E-22 and they are modified with SB, SBS, Terminal Blend Crumb Rubber or other types of approved polymers to enhance the performance of the PG binder. These binders are required for all item 404 asphalt mixture placements on the **mainline and shoulders only**, excluding shim, permeable base, temporary pavements, and miscellaneous (driveways, culvert inverts, curbs, sidewalks, bicycle paths, vegetation control strips, gutters, repairs, patching, etc.).

NOTE: A Special Note must be included in the contract documents indicating the grade of the PG binder and the number of gyrations for the calculated ESAL level for the roadway segment. The Note must also include the elastomeric property requirements for the Polymer Modified PG binder selected. See Section 6.2.6 of this chapter on the guidance of Special Note use.

Other PG binder grades not listed may be specified for a given location with approval from the Regional Materials Engineer and the Materials Bureau. The Regional Materials Engineer should be consulted for assistance in the PG Binder selection.

Table 6-4 Performance-Graded Binder Selection

Location	Location by Counties	Polymer Modified PG Binder Grades (Material Designation)
Upstate	All Other Counties Not Listed Under Downstate	64V-22[1,2] (702-64V22)
Downstate	Orange, Putnam, Rockland, Westchester, Nassau, Suffolk Counties and City of New York	64E-22 (702-64E22)

1. For high volume roadways in Dutchess County, PG 64E-22 may be specified with the concurrence of the Regional Materials Engineer.
2. For the Adirondack Region, PG 58E-34 (702-58E34) may be specified.

b. Neat PG Binder Grades – PG binder grades without polymer are used for placements such as shim, permeable base, temporary pavements and miscellaneous (driveways, culvert inverts, curbs, sidewalks, bicycle paths, vegetation control strips, gutters, repairs, patching, etc.). These include 64S-22 for Upstate and 64H-22 for Downstate.

c. Poly-Phosphoric Acid (PPA) - PPA is a chemical modifier that is currently prohibited from modifying any PG binder used for all Upstate projects because of its potential reaction with limestone aggregate since the primary aggregate for Upstate Regions is limestone. For Downstate Regions, the PPA modification of PG binder is restricted for limestone, RAP, or gravel aggregate with limestone. PPA is also restricted for use as a cross-linking agent during polymer modification of PG binders. It is very important that correct statements restricting PPA are included in the Special Notes specifying the PG binder types.

6.2.6 **Special Note**

The PG binder grade and the mixture's design level of "80 kN ESALs" (18-kip ESALs) must be conveyed by the Designer to the Contractor in the form of a Special Note in the proposal. Designers shall select the appropriate Special Note corresponding to the Mixture Design Level and PG Binder and insert it into the contract. The Special Notes can be accessed at the following link: ***https://www.dot.ny.gov/divisions/engineering/technical-services/materials-bureau/hma-specialnotes.*** These notes are specific to the project location, Upstate or Downstate, PG binder grade, and the Number of Gyrations for the calculated ESALs. Example of a Special Note for a PG binder is provided in Appendix 6A.

The following information is included in the Note:

a. Polymer Modified PG Binder Note

"Use polymer modified PG 64Z-22 meeting the requirements of AASHTO M 332, Standard Specification for Performance Graded Asphalt Binder using Multiple Stress Creep Recovery (MSCR), for the production of asphalt mixtures for this project. In addition, the PG binder grade must also meet the elastomeric properties as indicated by one of the following equations for %R3.2:

1. For $J_{nr3.2} \geq 0.1$, $\%R_{3.2} > 29.371 * J_{nr3}^{-0.2633}$
2. For $J_{nr3.2} < 0.1$, $\%R_{3.2} > 55$

Where,
$R_{3.2}$ = % recovery at 3.2 kPa
$J_{nr\ 3.2}$ = average non-recoverable creep compliance at 3.2 kPa

When terminal blend CRM PG binder is used, the following shall apply:

- *Crumb rubber particles shall be finer than #30 sieve size.*
- *The CRM PG binder shall be storage-stable and homogeneous.*
- *The Dynamic Shear Rheometer (DSR) shall be set at 2-mm gap.*
- *The CRM PG binder shall be 99% free of particles retained on the 600 µm sieve as tested in accordance with Section 5.4 of M 332."*

For "Z" in the polymer binder grade, use either "V" for Upstate or "E" for Downstate.

b. Neat PG Binder Note

"Use a PG 64X-22 meeting the requirements of AASHTO M 332, Standard Specification for Performance Graded Asphalt Binder using Multiple Stress Creep Recovery (MSCR), for the production of asphalt mixtures for this project. Terminal Blend Crumb Rubber modifier may be used for this PG binder.

When terminal blend CRM PG binder is used, the following shall apply:

- *Crumb rubber particles shall be finer than #30 sieve size.*
- *The CRM PG binder shall be storage-stable and homogeneous.*
- *The Dynamic Shear Rheometer (DSR) shall be set at 2-mm gap.*
- *The CRM PG binder shall be 99% free of particles retained on the 600 µm sieve as tested in accordance with Section 5.4 of M 332."*

For "X" in the binder grade, use either "S" for Upstate or "H" for Downstate.

c. PPA Restriction

For Upstate projects, the following statement is included in the Special Note:
"Use of poly-phosphoric acid (PPA) to modify the PG binder properties is prohibited for mixtures under this contract. This prohibition also applies to the use of PPA as a cross-linking agent for polymer modification."

For Downstate projects, the following statement is included in the Special Note:
"Use of poly-phosphoric acid (PPA) to modify the PG binder properties is prohibited for mixtures containing limestone, limestone as an aggregate blend component, limestone as a constituent in crushed gravel aggregate, or recycled asphalt pavement (RAP) that includes any limestone. This prohibition also applies to the use of PPA as a cross-linking agent for polymer modification."

d. Mixture Design Level

The ESAL calculations for asphalt mixture design levels are described in Section 4.5 and Section 6.2.2 of this manual. Designers shall select the appropriate Special Note for the Number of Gyrations corresponding to the calculated ESALs.

Table 6-5 Mixture Design Level

Calculated ESALs (million)	Number of Gyrations
<0.3	50
≥0.30 to <30	75
≥30	100

Note:
1. When the calculated ESALs are less than 3 million, the designer can choose a mixture design level of 50 gyrations, with the concurrence of the Regional Materials Engineer.
2. When the calculated ESALs are less than 50 million, the designer can choose a mixture design level of 75 gyrations for downstate, with the concurrence of the Regional Materials Engineer.
3. Parkways shall have a mixture design level of 75 gyrations.

6.2.7 Gradation Considerations

6.2.7.1 Base Course (404.37YZQR)

The base course is 37.5 F9 Base Course asphalt. Under certain conditions such as: when a thinner base course (4 inches or less) is required or maintaining traffic on the base course is a concern, 25 F9 Binder Course asphalt mixture may be used as a base course.

6.2.7.2 Binder Course (40W.25YZQR, 404.19YZQR)

The binder courses are 19 F9 Binder Course asphalt and 25 F9 Binder Course asphalt. The 19 F9 asphalt should be used when the binder layer will be left open to traffic through the winter season.

6.2.7.3 Top Course (404.12YZQR, 404.09YZQR, 404.068ZQR)

The top courses are 12.5 FZ Top Course asphalt, 9.5 FZ Top Course asphalt, and 6.3 FZ Top Course asphalt. 6.3 FZ Top Course is most prevalently used as preventive maintenance. When placing 6.3 FZ Top Course on a milled pavement, the milled surface must be micro-milled. In regions where gravel aggregates are present or on urban projects where a lot of handwork is necessary, the use of a 6.3 or 9.5 FZ Top Course asphalt is recommended.

Designers should make sure that the Regional Materials Engineer is consulted when deciding on the use of a 6.3 FZ Top Course for interstate arterials. Note: “Z” designation is related to aggregate friction F1, F2, and F3.

6.2.7.4 **Temporary Pavement (404.4X89QR)**

Temporary pavements are F9 asphalt used for crossovers and placements for less than one year. If the asphalt placement is intended temporarily for more than one year, then a standard asphalt friction course shall be used.

6.2.8 **Compaction Monitoring**

Proper in-place density of asphalt pavements is an essential component of pavement performance. NYSDOT uses four different compaction specifications to ensure proper density is achieved. The type of compaction specification depends first on the functional classification of the road, then the traffic volume, and last, the amount of material needed (less than 2000 tons or not), or the calculated ESALs (less than 0.3 million or not).

On roadways with full or partial control of access, regardless of the traffic volume, location (upstate or downstate), the asphalt mixture quantity, the calculated ESALs, or vibratory sensitivity, the compaction would be determined by a direct method, such as coring, to verify the density. On urban roadways with no control of access, it is reasonable to use indirect methods, such as density gauge readings to evaluate density.

Since the method of monitoring the density is part of the specification for the item, the designer needs to include this decision in selecting which item to specify. See Tables 6-1 and 6-2 to select the appropriate item number.

6.2.8.1 **50 Series Compaction Method (404.XX5ZQR)**

This method requires a Contractor to take cores daily to monitor pavement density. The results of these cores are used for incentive/disincentive payment. This compaction method should be specified on all full or partially controlled access roadways and applies only to Binder and Top (12.5 & 9.5) courses.

6.2.8.2 **60 Series Compaction Method (404.XX6ZQR)**

This method requires a Contractor to monitor pavement density using a density gauge. The Project Target Density (PTD) for monitoring pavement density is established using pavement cores and gauge readings from a test section. This compaction method should be specified on all roadways that are not fully or partially controlled access or when the asphalt quantity for the Top course is greater than or equal to 2000 tons for the Top course layer. This method should be used for the Base, Binder, and Top (12.5 & 9.5) courses.

6.2.8.3 **70 Series Compaction Method (404.XX7ZQR)**

This method requires a Contractor to monitor pavement density using a density gauge. The PTD for monitoring pavement density is established by peaking the density gauge on a test section. This compaction method should be used for the Base, Binder, Top (12.5 & 9.5), and True & Leveling courses.

The criteria for specifying this method is when:

- The asphalt mixture quantity for the Top course is less than 2000 tons regardless of other layer quantities or,
- A nominal thickness 1 inch or greater for True and Leveling course is specified in the contract documents.

6.2.8.4 **80 Series Compaction Method (404.XX8ZQR)**

This method requires a Contractor to compact the pavement by applying the number of passes specified in Table 404-3 of Section 404 of the Standard Specifications. This method should be specified for 6.3 FZ Top Course asphalt pavement, temporary pavements, miscellaneous placements, shoulders, bridge approaches (regardless of the project location), True & Leveling, Shim, etc., and where the distance of asphalt mixture placement does not permit the construction of a test section.

6.2.9 **Friction Aggregate Requirements**

Asphalt pavement friction is controlled primarily by the coarse aggregate component of the surface course. Department specifications allow only those coarse aggregate types found to provide design friction under design traffic conditions.

6.2.9.1 **Mainline Pavement Surface Layer**

The friction aggregate requirements for asphalt pavements are dependent on each project's specific design parameters. Friction requirements are designated by the fourth digit of the pay item extension. Depending on a projects design parameters coarse aggregate in the surface course, asphalt mixture must meet F1, F2 or F3 requirements. Use Tables 6.1 and 6.2 to select the proper aggregate requirements for each project. The aggregate requirements for the entire project are dictated by that segment within the project with the most stringent requirements.

6.2.9.2 **Miscellaneous Placements and Subsurface Layers**

Asphalt mixture for miscellaneous placements: driveways, culvert inverts, curbs, sidewalks, bicycle paths, vegetation control strips, gutters, repairs, patching, etc., and subsurface layers require coarse aggregate meeting F9 requirements. F9 requirements are specified by placing a 9 in the fourth digit of the pay item extension, see Figure 6.1.

6.2.10 **Quality Adjustment Items**

NYSDOT began making payment adjustments for the quality of asphalt pavement in 1990 for in-place density and in 1996 for plant production. These payment adjustments were based on the density of the finished pavement and/or the production quality of asphalt material. The payment adjustment will be made by *Quality Adjustment Factors* using a pay unit called a *Quality Unit*.

All the quality units are paid at a predetermined Index Price. The asphalt mixture index prices have been created based on asphalt mixture weighted average bid prices. One index price is used for all asphalt mixture quality adjustment items in a contract and applies for the duration of the contract. Index prices will be established and updated by an Engineering Bulletin annually and preprinted in the contract documents. Temporary pavements do not qualify for quality adjustments. There is no incentive for shim, permeable base, and miscellaneous placements. However, there is a disincentive for these items when the production does not meet the specification requirements and therefore, a quality adjustment item will be assigned to them for this purpose.

To simplify the Contractor's accounting procedures, separate quality payment items were created for each of the possible quality payment adjustments: plant production, pavement density, and longitudinal joint density. All quality adjustments will be paid under the appropriate quality adjustment item number in the contract documents. ***Note: The maximum QAF for plant production and pavement density is 1.05 each.*** The following guidance should be used for each type of quality payment adjustment:

1. Plant Quality Adjustment: The quality units for plant production adjustments are computed from the total tonnage of asphalt items in the contract eligible for plant quality adjustment. To estimate the total quality units for plant production for the contract, multiply the tons of asphalt mixture for each asphalt pay item by the maximum quality adjustment factor of **0.05,** then add all the estimated plant production quality units and enter this total into a plant quality pay item.

2. Density Quality Adjustment:

a. 50 Series Compaction: The quality units for 50 series pavement density adjustments are computed from the top and binder course tonnage on the traveled lanes and ramps longer than 1500 feet. Shoulders, tapers, maintenance crossovers, etc., are not subject to QAFs. To estimate the total quality units for 50 series compaction items for the contract, multiply the tons of asphalt mixture for each asphalt pay item by the maximum quality adjustment factor of **0.05**, then add all the estimated pavement density quality units and enter this total into a density quality pay item.

b. 60 Series Compaction: There is no incentive for 60-series compaction, therefore the designer will enter 1 quality unit in the estimate for projects with 60-series compaction only. There may, however, be a disincentive, and adjustment will be made based on the current quality index price for that region.

c. Longitudinal Joint: The quality units for longitudinal joint density adjustments are computed from the top course centerline miles on the mainline only for 50 and 60-series compaction. There is no density adjustment for longitudinal joints between lanes which are constructed using echelon paving. The maximum quality unit for longitudinal joint density adjustment is 4 quality units per segment. A segment is equal to one tenth of a mile of a longitudinal joint. To estimate the total quality units for longitudinal joint density adjustments for the project, first determine the project length in centerline miles and the number of lanes and then use the equation below and enter this total into a longitudinal joint density quality pay item. For projects with a divided highway, the designer shall calculate quality units with the equation below using the number of lanes in one direction and then multiplying the resulting quality units by 2 to estimate the total number of longitudinal joint quality units for the contract and enter this total into a longitudinal joint density quality pay item.

# of Quality Units (QU) = (# Lanes – 1) x 40 x Project Length (miles)

If the total project length is less than 1500 feet, then the designer does not have to enter a quality adjustment item number.

Table 6-6 Description of 404 Quality Adjustment Pay Items

404 Quality Adjustment Pay Items			**Calculated Quality Units apply for the following:**
404.0000**1R**	=	Plant Production Quality Adjustment	All asphalt items paid by the ton.
404.0000**2R**	=	Pavement Density Quality Adjustment	Only 50 and 60 series asphalt items.
404.0000**3R**	=	Longitudinal Joint Density Quality Adjustment	Only Top Course 50 and 60 series asphalt items.

Note: "R" is the Quality Adjustment Item specification revision.

3. Pavement Ride Quality Adjustment: Refer to section 6.7.1 Ride Quality for Asphalt Pavements, to determine the number of Quality Units required to be included in the contract.

6.2.11 Lift Thickness Limitations

In general, minimum lift thicknesses are established by the nominal maximum size of the aggregate that is to be compacted. Maximum lift thicknesses are set to ensure that the full thickness of the lift is adequately compacted. If the required course thickness of a given item exceeds the maximum permissible lift thickness, then multiple lifts are to be used to obtain the required course thickness. Table 6-7 lists the minimum and maximum lift thicknesses for the various nominal maximum aggregate sizes. Note that the lift thicknesses for multiple lifts are to be indicated on the typical section drawings for the project.

Table 6-7 Limits on Permissible Lift Thicknesses

Maximum Nominal Aggregate Size (mm)	Minimum Lift Thickness (inches)	Maximum Lift Thickness (inches)
37.5	4	6
25.0	3	5
19.0	2½	4
12.5	2	2½
9.5	1½	2
6.3	¾	1

6.2.12 Truing and Leveling (404.01Y90R, where Y =7 or 8)

Truing and Leveling (T&L) should be used at spot locations to remove irregularities in the old pavement, fill and patch holes, correct variations in banked pavement, establish pavement crowns, establish the proper cross-slope and grade, and for the terminations of the overlay as noted in section 5.4.2 of this manual. When a T&L course is required, it should be indicated on the typical sections in the plans with a specific aggregate size mixture since there is no specific

T&L material. When a mixture is not specified, the selection of the appropriate mixture will be left to the discretion of the Contractor depending on the thickness needed for the T&L course. This course will be of variable thickness and its material composition will be adjusted in accordance with the thickness required.

When choosing compaction method for T&L, the item with 70 Series method should be used when a nominal thickness to be placed is specified in the contract. However, a T&L item with 80 Series method should be used when T&L is specified to correct the grade and slope of the pavement section. These items are recommended to be used for all Functional Classifications and require aggregates meeting F9 requirements.

6.2.13 Vibratory Compaction Procedure

When the asphalt mixture is compacted using vibratory compaction equipment, there is a potential for damage to sensitive structures, such as weak, old masonry structures that are in close proximity

to the work or underlying utilities, etc. To determine if an area may have structures or utilities that could be damaged by vibratory compaction, the State Highway Maintenance supervisors, utility companies, and local highway maintenance officials should be consulted. When a section within the project limits is vibratory sensitive and has the potential of damage, it should be compacted using non-vibratory (static) compaction equipment. In that case, the limits of this section should be indicated in the plans. When the entire project is vibratory sensitive, a Special Note should be included in the proposal indicating that vibratory compaction should not be used for the project.

6.2.14 **Handwork**

When a project requires the asphalt mixture to be placed with a lot of handwork, consideration should be given to the use of 6.3 or 9.5 asphalt mixture with the concurrence of the Regional Materials Engineer. These mixtures are suited for this purpose because of a smaller stone size and generally, a well-graded aggregate mixture. In addition, this mixture can easily be placed and compacted with hand tampers or any other small compaction equipment.

6.2.15 **Tack Coat**

Tack coat enhances the bond between asphalt pavement lifts. Contact surfaces between all asphalt pavement lifts will therefore be tack coated in accordance with the Standard Specification Section 407 - *Tack Coat*, prior to placing the asphalt mixture. The only exception to this is the surface of permeable base course which does not require tack coat. 6.3 asphalt items require the use of straight tack coat. The application rates in Table 407-1 should be used to estimate the quantity of tack coat required.

6.2.16 **Joint Adhesive**

Joint adhesive enhances the bond of the pavement joints butting against a new asphalt placement. Vertical faces for all the joints on the surface course such as longitudinal, transverse, curbs, or other joints butting against the new asphalt pavement will have joint adhesive applied in accordance with Standard Specification Section 418 – *Asphalt Pavement Joint Adhesive.* The use of this item will be specified and clearly indicated in the plans when used with base and binder. This item will also be specified when it is known that either the Base or the Binder course will be left open to traffic over the winter or longer. Longitudinal joints between lanes made by echelon paving do not require joint adhesive.

6.3 PORTLAND CEMENT CONCRETE (PCC)

The majority of NYSDOT's Interstate system was constructed from 1960 through the mid 70's using PCC. Most of those pavements have outlived their intended service lives and many have been overlaid with HMA. Since the mid 80's through the early 90's, there had been a limited amount of new PCC pavement placed. These pavements were designed and built using shorter, 20' unreinforced slabs. Since the year 2000, concrete pavements have held similar unreinforced slab designs with minor changes in slab lengths (16') and geometry requirements.

The current PCC pavement design for new pavements is a Jointed Plain Concrete Pavement (JPCP) with 15' typical slab length, with edge drains. These pavements are typically constructed with Class C concrete, although High Early Strength concrete has been used in some areas. Details about PCC materials and construction are found in the Standard Specification Section 502 and the 502 Standard Sheets.

The following are the Department's guidelines for designing a PCC pavement:

6.3.1 **Project Selection**

Historically, PCC pavements have been considered when constructing or reconstructing roads projected to carry high traffic volumes and/or high equivalent single axle loads (ESALs). PCC pavements can also be an option for low volume roads or applied as an overlay. Concrete pavements may also be considered for areas where a service life of over 25 years is desired.

6.3.2 **Thickness Selection**

For newly constructed pavement, refer to Chapter 4 of this manual. The layer thicknesses must be shown in the plans. Consult the Materials Bureau for assistance in designing the pavements for streets and local roads or overlays.

6.3.3 **Pavement Hardware**

The type, size, and spacing of longitudinal joint ties, transverse joint supports (dowels), reinforcing mesh, and reinforcing steel are depicted in the 502 Series Standard Sheets for Portland Cement Concrete Pavements.

Mesh reinforcement is typically used when building 60’ long slabs. 60’ slabs are only used when matching new pavement to old 60’ slab systems. Consult the Materials Bureau when considering the use of 60’pavement slabs.

Heavily reinforcement is typically used on slabs that are out of geometry and in slabs that have manholes or drainage structures in them.

Alternate transverse joint support (dowels) may be specified depending on the installation conditions. Alternate dowels include stainless steel, purple epoxy coated, O-Dowels and others. These items may provide additional service life at a higher cost. Consult with the Materials Bureau to determine if an alternate dowel should be considered for a project.

6.3.4 **Projections Into The Pavement**

Whenever possible, drainage structures, utilities, and other projections into the pavement should be moved from travel lanes and into medians, shoulders, sidewalks, or other areas not routinely exposed to traffic. Such projections into the pavement:

- Reduce the concrete cross section, thereby decreasing structural capacity.
- Introduce complex joint layouts, irregular slabs, or high-cost heavily reinforced slabs.
- Require significant effort to properly consolidate the concrete and isolate the structure.
- Present weakened planes in plastic concrete which may initiate uncontrolled cracking.
- Interrupt paving.
- Result in bumps.

If projections must be placed in travel lanes:
Space them such that reasonable transverse joint layouts may be accommodated. In general, space projections such that their midpoints are at least 12’ apart longitudinally. This includes projections in different lanes. That is, to accommodate reasonable transverse joint layouts, assume all projections that occur across multiple lanes occur only in one lane. This one lane then controls transverse joint locations across multiple lanes.

- Center any portion of a projection that protrudes into the PCC between longitudinal joints. If centering between longitudinal joints is not possible, locate the structure such that any portion that protrudes into PCC is at least 1’ from any longitudinal joint. Avoid placing projections in the wheel paths or on longitudinal joints.
- Set the projection to a depth such that at least 4” of subbase can be placed between the top masonry surface of the projection and the bottom of the PCC slab isolating the projection.

6.3.5 Joint Layout

The need to provide a complete joint layout in the plans varies with project complexity. Generally, it is not practical to provide a complete joint layout in the plans because moving one joint during construction alters the layout significantly. It is recommended that the longitudinal joint locations be included in the plans if there are multiple maintenance and protection of traffic (M&PT) stages. Separate sheets devoted solely to joint layout, showing the longitudinal joint locations and projections within 10" of the bottom of the PCC slabs, are helpful to both the Contractor and Engineer when laying out joints at the project.

It is highly preferable to align longitudinal joints between travel lanes with the final longitudinal pavement markings. The Contractor is required to submit the final joint layout based on construction staging and the locations of projections, tapers, irregular areas, etc. The joint layout is subject to the Engineer's approval. Guidance for joint layout is found in Standard Sheets and Specifications.

For PCC intersections, a proposed joint layout should be included in the plans to provide the Contractor with a reasonable expectation of the work required. Intersection joint layouts are typically complex because of projections and intersecting centerlines. In the plans, reference Note 1 on Standard Sheet 502-07, Utility Isolation and Joint Layout - General Notes, to inform the Contractor that the joint layout is proposed only, and they are responsible for developing the final joint layout. The Field Engineering II Section of the Materials Bureau is available to assist in developing the proposed joint layout.

When designing a PCC intersection, extend the PCC limits to the point where asphalt rutting and shoving are likely to begin.

Discussion regarding the various types of pavement joints can be found in the 502 Standard Sheets.

6.3.6 Slab Geometry

Show the typical slab length and width in the plans. Refer to Standard Sheet 502-07 for limits on slab geometry and aspect ratio. Slabs that cannot meet this requirement may need to be heavily reinforced. When required, consult the Materials Bureau for assistance.

6.3.7 Work Zones

Whenever possible, remove traffic from the facility under construction or make work zones as large as possible. Large work zones foster smoother, longer lasting, and less costly pavements by:

- Allowing the use of high-quality, high-volume paving equipment.
- Minimizing short or irregular placements.
- Enhancing concrete delivery which reduces truck rejection, joint construction, and sub-optimal joint configurations.

6.3.8 Concrete

A. Class C Concrete. Standard PCC pavements are constructed from NYSDOT Class C concrete as defined in Section 501 of the Standard Specifications.

B. High-Early-Strength (HES) Concrete. In situations where an early opening to traffic is desired, usually before 7 days, an HES concrete can be specified. If an HES pay item is selected for a location, the contract documents should also include a work zone closure time frame for that location. The Contractor will design the HES mix based on the assigned closure time frame and the work required.

C. Performance Engineered Mix (PEM). PEM concrete mixtures are specifically designed to meet the requirements of a particular application. It allows the concrete supplier and contractor to innovate and produce as well as place concrete in a more efficient manner. When specifying a PEM mixture, the Contract Documents shall include concrete requirements (i.e. compressive strengths, flexural strengths, freeze/thaw durability, air content, resistivity, etc.) and a Quality Control/ Quality Assurance (QC/QA) procedure. Contact Main Office Materials to assist in the development of the project's concrete requirements and QC/QA procedure.

6.3.9 **Smoothness Requirements**

Concrete pavement ride quality requirements are dependent on several items. Guidance regarding selection of ride quality items, calculation of Quality Units (when applicable) or the inclusion of Diamond Grinding items can be found in Section 6.7.2.1 Ride Quality of Concrete Pavements.

6.3.10 **Shoulder Type Selection**

Consult the Materials Bureau for assistance in selecting the shoulder material type.

Use tied PCC shoulders or tied PCC curbs and/or gutters if the outer slabs cannot be widened 1' beyond the travel lane width as depicted in the Standard Sheets. If the outer slabs can be widened 1', there are advantages to using full-depth asphalt shoulders. Asphalt shoulders:

- Are typically less costly for initial construction.
- Result in less full-depth PCC removal and replacement costs on future Concrete Pavement Restoration (CPR) projects.
- Will not crack due to poor width-to-length ratios
- Can simplify construction, particularly when projections are in the shoulder.

Tied PCC shoulders, used to maintain traffic during construction, should be constructed with transverse joint supports.

6.3.11 **Ramp Type Selection**

After a ramp diverges from the mainline pavement, treat it as a separate design. Consider the anticipated traffic volume and geometrics when deciding between full-depth PCC or asphalt ramps.

6.3.12 **Friction Aggregate Requirements**

There are four levels of friction aggregate requirements for PCC pavement, types 1, 2, 3, and 9. Use the following table – 6.3.12.1 *Friction Aggregate Types* to select the appropriate type for each project. The requirements for each type are given in Section 501 of the Standard Specifications. Use the Basis of Payment in Section 502 to select the appropriate item numbers.

6.3.12.1 Friction Aggregate Types		
Traffic	**Location**	**Friction Aggregate Type**
High Volume(1)	Downstate(3)	Type 1
	Upstate(3)	Type 2
Low Volume(1)	All	Type 3
Nontraffic(2)	All	Type 9

1. "High Volume" refers to 2- or 3-lane highways with design year, two-way AADT over 8,000, or for more than three lanes, with two-way AADT over 13,000. "Low Volume" refers to highways with lower volumes for the specified number of lanes.
2. "Nontraffic" refers to areas such as shoulders, gore areas, and gutters that do not routinely carry traffic.
3. "Downstate" refers to the City of New York and the surrounding counties of Dutchess, Nassau, Orange, Putnam, Rockland, Suffolk, and Westchester. All other areas are referred to as "upstate.

6.3.13 **Texturing Concrete Pavements**

Section 502 of the Standard Specifications includes three different texture requirements. Include a note in the project plans identifying the required texture method. When possible, select one texture type for each project. Using multiple textures on a project is not recommended. If multiple textures are used on a project, clearly identify the limits of each texture type. If no method is identified, the specification requires the Contractor to apply a longitudinal tined texture.

Longitudinal tining imparts a texture on the pavement surface by dragging a rake with uniform tine spacing along the pavement surface parallel to the centerline. It is the preferred texturing method for design traffic speeds of 40 mph or higher, but it can be used for pavements with any design speed. Longitudinal tining will reduce tire noise several decibels below that resulting from transverse tining.

Artificial turf drag imparts a texture on the pavement by dragging a section of artificial turf along the pavement surface parallel with the centerline. Artificial turf drag can only be used when design traffic speeds are below 40 mph. It is the preferred texturing method for pavements that will be constructed in short segments, such as intersections, where texturing is likely to be done by hand.

Transverse tining imparts a texture on the pavement surface by dragging a rake with nonuniform tine spacing across the pavement surface perpendicular to the centerline. This treatment can be used for pavements with any design speed. However, transverse tining is the noisiest of all texturing techniques and should be avoided, unless longitudinal tining methods are impractical.

6.4 PERMEABLE BASE

The permeable base course is intended to quickly remove water that infiltrates the pavement to an edge drain system, thus preventing the lower pavement layers from becoming saturated and losing strength (which reduces pavement life). It is a free-draining layer, capable of draining both surface water and preventing water accumulation from the subbase below. Typically, water drains through it as fast as it enters in, retarded only by the cross-slope and any obstructions. Type 2 Asphalt Treated Permeable Base (ATPB) is the only treated permeable base allowed and is used only with asphalt pavements. ATPB is a mixture of asphalt and coarse aggregate with less strength than other asphalt layers but providing some structural support and permeability at the same time. Once the permeable base layer is placed and compacted, the surface must be protected from any damage or debris which may decrease the strength or permeability of the mixture.

Refer to Chapter 9 of this manual for further discussion of permeable base and Appendix 5B for a listing of current item numbers.

For constructability reasons, the minimum thickness of permeable base is 4 inches.

6.5 SUBBASE COURSE

Subbase course is used to provide support for PCC slabs and as a structural component for asphalt pavements. The ideal subbase is strong, uniform, and free draining. Strength is derived from the gradation of the material and its placement. Uniformity is provided by stockpiling subbase material. The free draining characteristic depends on the percentage of fine particles (fines). Unfortunately, a granular material derives more of its strength by packing the voids with fines. Because of the allowance of up to 10% fines, the subbase is considered an impermeable layer, not free draining.

Section 304 of the Standard Specifications describes the material requirements for subbase course. The most commonly used subbase is Type 1, followed by Optional Type and Type 4. The specifications allow the use of some recycled materials for subbase such as Recycled Concrete Aggregate and Reclaimed Asphalt Pavement. Subbase Course, Type 1011-2 is used in Regions 10 and 11 and allows the use of locally available materials in subbase construction. Consult the Regional Geotechnical Engineer for questions concerning using special subbase specifications. The subbase layer is typically 12 inches thick.

6.6 SUBGRADE

6.6.1 **Subgrade Improvements**

The purpose of the subgrade area is to provide a uniform, stable platform on which to place the pavement structure and to minimize differential frost heaves. The subgrade area is generally defined as that portion of an embankment situated above: (1) a line located 2 feet below the subgrade surface and extended to the intersection with the embankment side slopes, OR (2) the embankment foundation, whichever is higher (refer to NYSDOT Standard Specification book subsection 203-1.05.) This area excludes any material placed under another specification, particles greater than 6 inches, or unsuitable material.

Methods to improve the subgrade area are as follows:

1. Reduce the amount of water in the subgrade area. Improve drainage by creating roadside ditches to a depth of 4 feet, measured from the pavement edge to the ditch flow line. Underdrains and crushed stone trenches may be used to lower the water table in cut sections; see Chapter 9 of this manual for more information. Also note when modifying a ditch cross section it is important to consider the traversability of the section relative to the design clear zone. See HDM Chapter 10.

2. Minimize differential frost heaves or increase load-bearing capacity. The most common method is to remove unsuitable (organic) or unstable (saturated) materials and replace them with select granular subgrade material. Item 203.20 Select Granular Subgrade of the Standard Specifications is typically used.

Subbase material alone or in combination with a geotextile may also replace removed material. Rock should be fragmented and drained. Transition sections at culverts and in boulder removal areas are also used to provide uniformity.

3. Stabilize subgrade. Stabilize the subgrade with rollers that are 30 to 50 ton proof-roller-type compactors (refer to NYSDOT Standard Specification Section 203.) Mix in-situ material to break up stratified layers into more uniform material. Clayey soils can be stabilized by adding lime.

The designer should always contact the Regional Geotechnical Engineer for subgrade improvement recommendations.

6.6.2 Subgrade Resilient Modulus – M_r

The subgrade resilient modulus, M_r, is a measure of the stiffness of the subbase and subgrade soils. It is a necessary component for determining the pavement thicknesses of asphalt pavements. See section 4.5.3 of this manual. The higher the M_r, the stronger the subgrade soil, and the better support it will provide to the pavement.

The designer should contact the Regional Geotechnical Engineer to obtain a value for the subgrade resilient modulus, M_r. For reconstruction projects, M_r values can be determined by either taking soil samples (by comparing blow counts with visual descriptions) or Falling Weight Deflectometer (FWD) testing along the proposed project route. For new projects or widenings, M_r values can be found by taking soil samples.

M_r values below (4,000 psi) may signify a fine-grained soil. Poorly drained soils will also have lower M_r values. M_r values below (3,000 psi) indicate soft soil, probably with poor drainage, and offers weak subgrade support. M_r values from 5,000 to 7,000 psi are characteristic of fine to medium-grained soil and are typical values for most NYS roadway subgrades.

6.7 RIDE QUALITY

6.7.1.1 Ride Quality for Asphalt

Ride Quality items are included to incentivize the production of smooth asphalt pavement. Ride quality items, 653.1010 Level 1 Ride Quality for Asphalt or 653.1020 Level 2 Ride Quality for Asphalt should be included in a contract under the following conditions;

6.7.1.1 Item Selection for Ride Quality of Asphalt Pavements

Road Type	Mill?	Pavement Thickness*	RQ Type
Interstate	Yes	Greater than 1”	Level 1
		Less than or equal to 1”	Level 2
	No	Greater than 2.5”	Level 1
		Less than or equal to 2.5”	Level 2
Arterial	Yes	Greater than 3”	Level 1
		Less than or equal to 3”	Level 2
	No	Greater than 4”	Level 1
		2.5” to 4”	Level 2
		Less than 2.5”	N.A.

*True and Level courses should only be included in the pavement thickness if it has a nominal design thickness over 1”

Pavment surface treatments less than ¾” nominal thickness are not subject to ride quality testing.

Situations may arise where separate areas of Level-1 and Level-2 conditions exist within a single project. Similarly, a project may contain areas that don’t meet the criteria of either Level and therefore shouldn’t be included for Ride Quality testing. For these reasons, the designer should specifically designate areas to include Ride Quality testing in the plans, as well as the specified Level.

6.7.1.2 **Calculating Ride Quality Units for Asphalt**

To calculate the maximum number of quality units and the fixed price for the Ride Quality Item, the following steps should be taken:

1. Calculate the total number of lane-miles receiving Ride Quality.
2. Subtract the length of each bridge plus 50 feet. (25 feet lead in, 25 feet lead out.)
3. Exclude the following sections:
    a. Sections less than 1,320 feet in length,
    b. Sections within 200 feet of any traffic control device or intersection,
    c. Tapered sections less than a full lane-width,
    d. Roadways or ramps with posted speed less than 45 mph,
    e. Shoulders, gore areas, turn-outs, turn-arounds, driveways, parking areas and other similar miscellaneous paving.
4. Divide the total from the sum of steps 1 and 2 by 528 feet. The result is the total number of pavement ride quality (PRQ) lots.
5. Multiply the result of Step 4 by the appropriate maximum available Quality Units as determined from Tables 653-01 and 653-02 – (see Standard Specification 653). The result is the maximum number of quality units available.
6. Multiply the result of Step 5 by the Index Price for the Region in which the project resides. The index price for each Region is updated annually and is found in the Engineering Bulletin entitled, Index Prices for Use with Quality Adjustment Items. The result is the maximum incentive for the project.

If a project contains areas with multiple pavement types or ride quality levels, add the appropriate incentives for all the areas to determine maximum potential incentive for the project.

6.7.1.3 **Additional Ride Quality Considerations for Asphalt**

Milling Items: When specifying a Ride Quality specification for a rehabilitation project that includes production cold milling, use item number 490.15 –Production Cold-Mill Surface Planing of Bituminous Concrete. If the project requires that a composite pavement be milled neatly to the underlying concrete, the traditional cold milling items should be used.

Milling can be a major factor in constructing a smooth pavement. If the milling produces a rough profile, or fails to minimize an existing rough profile, it is more difficult to achieve a smooth final product. There are limited opportunities to eliminate surface irregularities. It is advantageous for the contractor to pave on a milled surface with minimal bumps or dips.

Conditioning the Existing Pavement: Refer to Section 404-3.05, Conditioning of Existing Surface, and include Items from Section 633, Conditioning Existing Pavement Prior to Asphalt Overlay to enable the contractor to prepare the pavement surface prior to placing intermediate and top courses of asphalt.

Truing and Leveling/Shim Course: Include quantities of truing and leveling (T & L) and/or shim course in the project. Isolated conditions may be present that necessitate the use of T & L and/or shim to prepare the roadway prior to paving binder or top course. These conditions include but are not limited to repairing raveled joints and adjacent areas, areas of asphalt delamination from the underlying course (particularly following milling), crack sealants (bands of crack sealant can cause the asphalt mat to fold over itself during rolling if not shimmed first), minimizing bumps and dips, and restoring proper cross-slope. Consult with the Regional Materials Engineer for further assistance in quantifying T & L and/or shim for a project.

Paving Widths: Caution should be taken if specifying simultaneous paving of multiple lanes. As the screed of a paving machine is extended, the paving machine's stability decreases which can cause oscillation of the screed (raising one side while simultaneously lowering the other). The oscillations can cause roughness to the pavement surface in the form of humps and dips. Tandem paving should be considered if avoidance of a cold longitudinal joint is intended.

Drainage Structures, Manholes and Other Utilities: Occasionally, features such as drainage inlets, manholes, and other utility structures are encountered in or near the roadway surface on ride quality projects. Items to adjust structures should be included in the contract to allow the contractor to pave through the area and set the structure to the proper grade, allowing for the smoothest transition possible. When shoulder areas containing structures are to be paved simultaneously with an adjacent travel lane, items to adjust those structures should also be included.

6.7.2.1 **Ride Quality for Concrete Pavement**

New concrete pavement will either include ride quality items, 653.2010 Level 1 Ride Quality for Portland Cement Concrete Pavements or 653.2020 Level 2 Ride Quality for Portland Cement Concrete Pavements or include a 505 Diamond Grinding Item.

Projects that consist of significant production paving will include the paving items and the 653 Ride Quality item. In this scenario the Contractor may elect to pave to achieve ride quality requirements, or Diamond Grind after paving at no additional cost to the Department.

Diamond Grinding items may be used when shorter pavements are placed in situations where it would be difficult to achieve ride quality using conventional paving practices. When Section 505 Diamond Grinding items are used, the Contractor will be paid to perform the grinding operation and will not receive Ride Quality Adjustment Item.

The following charts will be used to determine the appropriate item(s) to be included in the contract.

6.7.2.1.1 ITEM SELECTION FOR NEW CONSTRUCTION PCC PAVEMENTS

Pavement Type	Intersection or Mainline?	Strenuous Paving Conditions ?	Speed Limit	Item number	Item name
New Pavement	Intersection	N.A.	N.A.	505.0201 505.0202	Production Grind- New PCC Pavement 70 IRI Maximum Production Grind- New PCC Pavement 70 IRI Maximum w/ Slurry Removal
	Mainline	Yes	<45	505.0201 505.0202	Production Grind- New PCC Pavement 70 IRI Maximum Production Grind- New PCC Pavement 70 IRI Maximum w/ Slurry Removal
			≥45	505.0201 505.0202	Production Grind- New PCC Pavement 70 IRI Maximum Production Grind- New PCC Pavement 70 IRI Maximum w/ Slurry Removal
		No	<45	505.0201 505.0202	Production Grind- New PCC Pavement 70 IRI Maximum Production Grind- New PCC Pavement 70 IRI Maximum w/ Slurry Removal
			≥45	Refer to RIDE QUALITY ITEM SELECTION table	N.A.

6.7.2.1.2 RIDE QUALITY ITEM SELECTION FOR NEW PCC PAVEMENTS		
Pavement Thickness	RQ Level	Item
Greater than 6”	Level 1	653.2010
Less than or equal to 6”	Level 2	653.2020

6.7.2.2 **Calculating Ride Quality Units for Concrete Pavement**

To calculate the maximum number of quality units and the fixed price for the Ride Quality Item, the following steps should be taken.

1. Calculate the total number of lane-miles receiving Ride Quality.
2. Subtract the length of each bridge plus 50 feet. (25 feet lead in and 25 feet lead out.)
3. Exclude the following sections
    a. Sections less than 1,320 feet in length,
    b. Sections within 200 feet of any traffic control device or intersection,
    c. Tapered sections less than a full lane-width,
    d. Roadways or ramps with posted speed less than 45 mph,
    e. Shoulders, gore areas, turn-outs, turn-arounds, driveways, parking areas and other similar miscellaneous paving.
4. Divide the total from the sum of steps 1 and 2 by 528 feet. The result is the total number of pavement ride quality (PRQ) lots.
5. Multiply the result of Step 4 by the appropriate maximum available Quality Units as determined from Tables 653-01 and 653-02 – (see Standard Specification 653). The result is the maximum number of quality units available.
6. Consult the materials Bureau to determine the appropriate value of a ride quality adjustment factor. Multiply the result of Step 5 by the determined value of the ride quality adjustment factor to calculate the maximum ride quality incentive in the project.

6.7.2.3 **Ride Quality/Diamond Grinding Items for Concrete Pavement Rehabilitation Projects**

Concrete Pavement Restoration (CPR) projects are intended to restore an existing concrete pavement back to a high level of service. Repair of damaged slabs alone may not significantly improve the ride of the roadway. The designer has the option of including a diamond grinding item to restore the ride. If there are limited repairs throughout the project, the designer may select item 505.01XX Bump Grinding and grind the areas of repair only. This item is measured by the square yard and only grinds areas within 6’ of a repair.

If there are numerous repair locations, or if a high level of smoothness is required, the designer should consider 505.04XX Production Diamond Grinding- Pavement Preservation.

6.7.2.3.1 ITEM SELECTION FOR DIAMOND GRINDING OF EXISTING PAVEMENTS				
Pavement Type	Intersection or Mainline?	Speed Limit	Item number	Item name
Existing Pavement	Intersection	N.A.	505.0401 505.0402	Production Grind- Pavement Preservation Production Grind- Pavement Preservation w/ Slurry Removal
	Mainline	<45	505.0101 505.0102 505.0401 505.0402	Bump Grinding- PCC Bump Grinding- PCC w/ Slurry Removal Production Grind- Pavement Preservation Production Grind- Pavement Preservation w/ Slurry Removal
		≥45	505.0101 505.0102 505.0401 505.0402	Bump Grinding- PCC Bump Grinding- PCC w/ Slurry Removal Production Grind- Pavement Preservation Production Grind- Pavement Preservation w/ Slurry Removal

Quality Units. When including items 505.04XX, also include item 505.0403 Smoothness Quality Adjustment. The number of Quality Units to include for this is equal to 10% of the square yards to be Diamond Ground. This is a fixed price item. Consult with the Materials Bureau to determine the price to be included in the contract.

6.8 DIAMOND GRINDING

6.8.1 **Project Selection**

Diamond Grinding will be used on PCC pavements that are not qualified for ride quality, but a high level of smoothness is desired. Refer to *6.7.2.1 Ride Quality For Concrete Pavement* for necessary item selection guidance.

Diamond Grinding may be used on asphalt and PCC projects to correct poor ride quality or other surface defects, at no expense to the Department.

6.8.2 **Slurry Removal**

Slurry must not be deposited on business or residential property or into:

- Closed drainage systems.
- Occupied travel lanes.
- Wetlands, streams, estuaries, or sensitive environmental resources.
- Areas where it will become a public nuisance.

Slurry disposal must be disposed of in accordance with all Federal, State, and local regulations. Contact Regional construction and environmental groups for additional guidance regarding slurry removal.